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Research Article

# MANAGEMENT OF EARLY BLIGHT DISEASE OF TOMATO (*Alternaria solani*) THROUGH CHEMICAL FUNGICIDES UNDER FIELD CONDITION

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**Abstract:** Early blight disease of tomato caused by *Alternaria solani* is one of the most destructive diseases which cause considerable loss in tomato production. In the absence of resistant cultivars, the management of tomato early blight disease has relied principally on the application of chemical fungicides. The present study evaluated the effects of chemical fungicides on tomato early blight disease and investigated the efficacy of the yield of tomato plants. The field experiment used a randomised block design, with seven treatments and three replications in subtropical climatic condition of West Bengal at Regional Research Sub-Station (R & L Zone), Bidhan Chandra Krishi Viswavidyalaya, Sekhampur, Birbhum, West Bengal, India during *Rabi*, 2016-17 and *Rabi*, 2017-18. Two times foliar spray at an interval of 15 days with Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha was best followed by Azoxystrobin 18.2% + Difenoconaole 11.4% SC @ 1000 ml/ha and Trifloxysytrobin 25% + Tebuconazole 50% WG.The findings of the present study demonstrated a promising approach of management of early blight disease of tomato with chemical fungicides.

**Keywords:** *Chemical fungicides, Early blight, Tomato*

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## Introduction

The tomato (*Solanum lycopersicum*) plant belonging to the Solanaceae family is a short duration remunerative vegetable with high nutritive value and antioxidant properties [1]. It exerts several beneficial effects on health and it is rich in vitamin A, B, C, minerals, organic acids, and sugar [2]. Tomato is also used as various food products, such as ketchup, soup, paste, and powder [3]. *Alternaria solani* is known to cause early blight of tomato [4] that is economically one of the most important diseases of tomato in the world over, where it causes significant reductions in yield of 35 to 78 % [5]. Early blight is widespread throughout the tropics and temperate zones [6]. The disease occurs in all parts of the country causing a loss in yield. The yield loss due to early blight disease in tomatoes ranged from 0.75 to 0.77 t/ha for every 1% increase in disease severity [7]. As high as 86 percent yield loss has been reported (50- 86%) in tomatoes [8]. One percent increase in disease intensity can reduce yield by 1.36 percent, and severe disease can result in crop failure [9]. Among fungal diseases, blight caused by *Alternaria* species was the most predominant with the crop loss in the field ranging from 70-100 percent as reported from a survey and assessment of losses in West Bengal, India [10]. The disease is the most damaging to tomato because of its complete defoliation [11]. The most important hosts of the disease are tomato, potato, brinjal, chili, and black nightshade [12]. Other non-solanaceous hosts are cucumber, zinnia, wild cabbage, and horsenettle [13]. Thomma (2003) [14] identified that the *Alternaria* spp. produced melanin in the spores and the production of host-specific toxins and nonspecific toxins such as alternaric acid. In both greenhouse and field experiments, fungicide application is a significant factor in early blight control [15]. In the absence of resistant cultivars, the treatment of tomato early blight disease has primarily relied on the use of synthetic fungicides. The present study evaluated the effects of chemical fungicides on tomato early blight disease and investigated the efficacy of the yield of tomato plants. Results of this work could be used as an effective strategy for the management of early blight disease of tomatoes.

## Materials and Methods

The trial was taken up to evaluate the effectiveness of some chemical fungicides in managing *Alternaria solani* causing early blight in tomato crop. The field experiment was set up in a randomised block design with seven treatments and three replications in West Bengal's subtropical climate at Regional Research Sub-Station (R & L Zone), Bidhan Chandra Krishi Viswavidyalaya, Sekhampur, Birbhum, West Bengal, India during Rabi, 2016-17 and Rabi, 2017-18. The crop was maintained with judicious irrigation, and all agronomic practices and fertilizer schedules were followed according to standard procedures. 25 days old seedlings were transplanted in the main field. Tomato leaves showing typical early blight symptoms were collected from the field and examined microscopically to confirm the presence of the fungus *Alternaria solani*. Fungicides were sprayed after the first appearance of symptoms of early blight disease in the leaves. Two spraying at 15 days interval were done. Disease severity assessment was carried out on a scale of 0 to 9 according to Latha *et al*. (2009) [16] where: 0 = healthy; 1 = 1-5%; 2 = 6-10%; 3 = 11-25%; 5 = 26-50%, 7 = 51-75%, and 9 = > 76% of the leaf area infected with early blight symptoms. Percentage Disease Index was worked out using the formula, PDI = [Sum of all numerical rating/total number of observations taken x maximum disease score] x 100 [17].

| | | |
|---|---|---|
| Variety | : | Amlik |
| Design | : | RBD |
| Plot size | : | 5 × 4 sq. m |
| Spacing | : | 60×45 cm |
| Treatment | : | Seven |
| Replication | : | Three |

## Results and Discussion

Results presented in [Table-2] and [Fig-1] from the experimental trials revealed that all the treatments reduced the disease severity of early blight disease over (T7) control. Depending on the prevailing weather conditions, maximum disease severity (50.14%) was recorded in control.

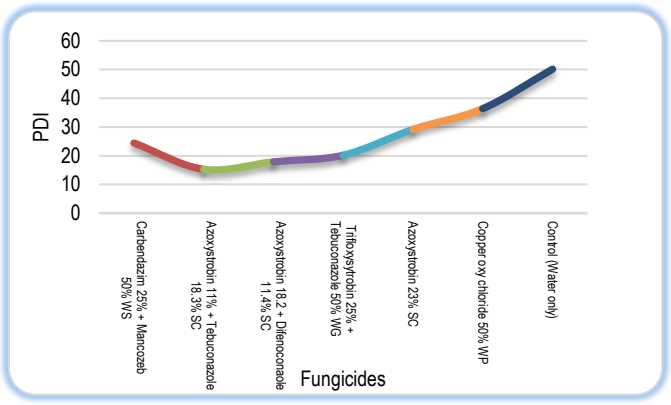


Fig-1 Percent disease index (PDI) in different fungicides against early blight disease of tomato

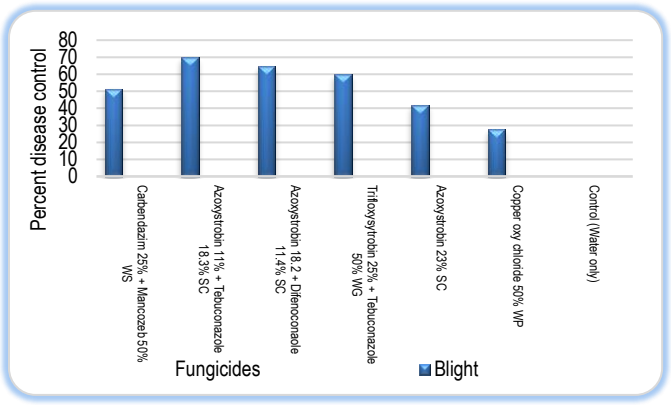


Fig-2 Influence of fungicides on Early blight disease control in tomato

Among the treatments the lowest disease severity was observed from $T_2$: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha (15.25%) followed by $T_3$: Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC @ 1000 ml/ha (17.86 %), $T_4$: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (20.16 %) and $T_1$: Carbendazim 25% + Mancozeb 50% WS @ 700 g/ha (24.42 %) at 15 days after 2nd spray. Results among these four treatments ($T_2$, $T_3$, $T_4$ & $T_1$) were found good efficacy against the disease over control. The per cent reduction in PDI was also calculated over control [Table-2] and [Fig-2]. The data revealed that highest disease control was in $T_2$: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha (69.59%) followed by $T_3$: Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC @ 1000 ml/ha (64.38 %), $T_4$: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (59.79 %) and $T_1$: Carbendazim 25% + Mancozeb 50% WS @ 700 g/ha (51.30 %) at 15 days after 2nd spray. All treatments controlled effectively the early blight disease in tomato.

Table-1 *Treatments details of fungicides*

| Treatments | Fungicides | Dosage (ml/g per ha) |
|---|---|---|
| $T_1$ | Carbendazim 25% + Mancozeb 50% WS | 700 |
| $T_2$ | Azoxystrobin 11% + Tebuconazole 18.3% SC | 1000 |
| $T_3$ | Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC | 1000 |
| $T_4$ | Trifloxysytrobin 25% + Tebuconazole 50% WG | 350 |
| $T_5$ | Azoxystrobin 23% SC | 500 |
| $T_6$ | Copper oxy chloride 50% WP | 2500 |
| $T_7$ | Control (Water only) | -- |

The yield data has been presented in [Table-3] and [Fig-3]. The results revealed that maximum yield was obtained from $T_2$: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha (35.40 t/ha) followed by $T_3$: Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC @ 1000 ml/ha (34.32 t/ha), $T_4$: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (32.85 t/ha) and $T_1$: Carbendazim 25% + Mancozeb 50% WS @ 700 g/ha (30.76 t/ha %) at 15 days after 2nd spray. The lowest yield was recorded in control (21.26 t/ha). Highest increase of yield was calculated from $T_2$: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha (66.51%) followed by $T_3$: Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC @

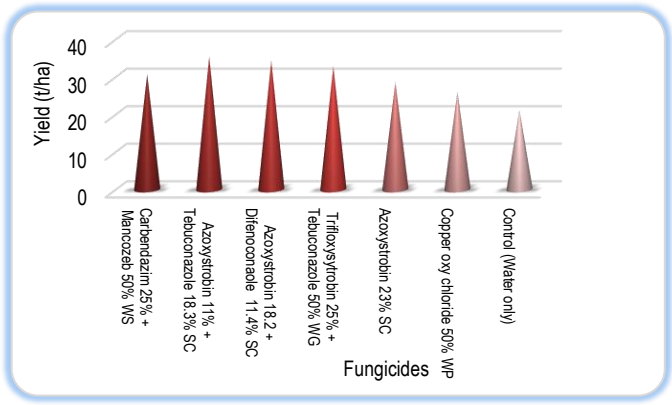


Fig-3 Effect of fungicides on yield of tomato

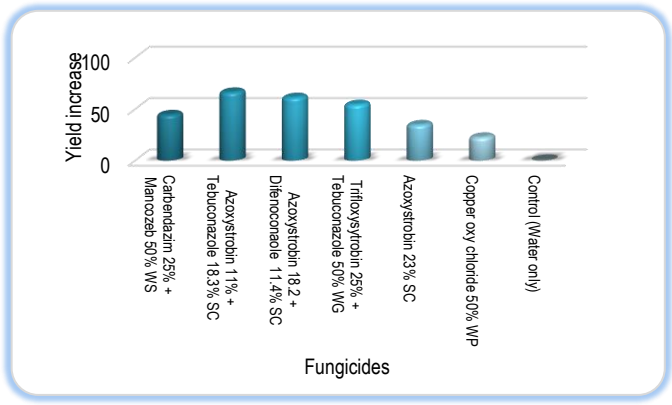


Fig-4 Influence of fungicides on yield increase in tomato

Fig-5 Symptoms of early blight disease on foliage of tomato crop

1000 ml/ha (61.43 %), $T_4$: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (54.52 %) and $T_1$: Carbendazim 25% + Mancozeb 50% WS @ 700 g/ha (44.68 %) presented in [Table-3] and [Fig-4].

The combination of Azoxystobin and Tryfloxystrobin in combination with Tebuconazole proved to be in synergy as the individual components have different modes of action. Azoxystrobin inhibits fungi respiration by disrupting the electron transport chain, thereby preventing ATP synthesis; it binds to the Complex III Qo site within the mitochondrion. Tebuconazole, a triazole acts as demethylation inhibitor (DMI) in fungal sterol biosynthesis and is highly susceptible to cross resistance, but it has excellent broad-spectrum activity for disease control. By using a component with a distinct mode of action, the risk of cross resistance is reduced. Trifloxystrobin, a Quinone outside Inhibitor (QoI), has been shown to influence fungi mitochondrial respiration [18,19]. The results of the research data conducted by Sharma *et al*., (2018) [20] revealed that, Difenoconazole 25 EC was also found superior in managing the A. Solani of tomato. Saha *et al*., (2018) [21] experimented Trifloxystrobin 25% + Tebuconazole 50%-75 WG molecule on Leaf Spot of Cabbage and found promising results. Sreenivasulu *et al*., (2019) [22], in their studies opined that the Tebuconazole 25.9 % EC @ 0.1% was most effective followed by copper oxychloride 50 % WP @ 0.30% less in found fairly economical for the management of early blight disease along with significantly highest fruit yield. Similar results were found by Datar (1996) [23] that Carbendazim was most effective for fruit rot caused by *A. alternata*.

Table-2 *Effect of chemical fungicides against early blight disease of tomato during 2016-17 and 2017-18 under field condition*

| Treatments | | Dose | PDI on leaves | |
|---|---|---|---|---|
| | Fungicides | (ml/g per ha) | 15 days after 2nd spray | Per cent reduction over control |
| $T_1$ | Carbendazim 25% + Mancozeb 50% WS | 700 | 24.42(29.61) | 51.30 |
| $T_2$ | Azoxystrobin 11% + Tebuconazole 18.3% SC | 1000 | 15.25(22.99) | 69.59 |
| $T_3$ | Azoxystrobin 18.2% + Difenoconaole 11.4% SC | 1000 | 17.86(25.00) | 64.38 |
| $T_4$ | Trifloxysytrobin 25% + Tebuconazole 50% WG | 350 | 20.16(26.68) | 59.79 |
| $T_5$ | Azoxystrobin 23% SC | 500 | 29.16(32.68) | 41.84 |
| $T_6$ | Copper oxy chloride 50% WP | 2500 | 36.38(37.10) | 27.44 |
| $T_7$ | Control (Water only) | -- | 50.14(45.08) | 0.00 |
| | S Em (±) | | 0.954 | |
| | CD 5% | | 2.94 | |

*Two years pooled data. Values are means of three replications, Values in parentheses are arcsine-transformed values*

Table-3 *Effect of fungicidal management on yield of tomato during 2016-2017 and 2017-2018*

| Treatments | | Dose | PDI on leaves | |
|---|---|---|---|---|
| | Fungicides | (ml/ha) | Fruits Yield (t/ ha) | Yield increases over control (%) |
| $T_1$ | Carbendazim 25% + Mancozeb 50% WS | 700 | 30.76 | 44.68 |
| $T_2$ | Azoxystrobin 11% + Tebuconazole 18.3% SC | 1000 | 35.40 | 66.51 |
| $T_3$ | Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC | 1000 | 34.32 | 61.43 |
| $T_4$ | Trifloxysytrobin 25% + Tebuconazole 50% WG | 350 | 32.85 | 54.52 |
| $T_5$ | Azoxystrobin 23% SC | 500 | 28.67 | 34.85 |
| $T_6$ | Copper oxy chloride 50% WP | 2500 | 26.10 | 22.77 |
| $T_7$ | Control (Water only) | -- | 21.26 | 0.00 |
| | S Em (±) | | 1.65 | |
| | CD 5% | | 5.07 | |

*Two years pooled data. Values are means of three replications*

## Conclusion

The result of the present investigation is comparable with the findings of the previous researchers. Based on findings of the present study, it may be concluded that two times foliar spray at an interval of 15 days with Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha was best followed by Azoxystrobin 18.2% + Difenoconaole 11.4% SC @ 1000 ml/ha and Trifloxysytrobin 25% + Tebuconazole 50% WG which may be recommended to control of the early blight disease in tomato in West Bengal condition.

**Application of research:** Using of Strobilurin groups of fungicides (Azoxystobin and Tryfloxystrobin) in combination with Tebuconazole, a trizole fungicide, had a better control on early blight disease of tomato.

**Research Category:** Plant disease management by chemical fungicide

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University: Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, India
Research project name or number: Research station study

**Author Contributions:** Sole Author
**Author statement:** Author read, reviewed, agreed and approved the final manuscript. Note-Author agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

**Study area / Sample Collection:** Regional Research Sub-Station (Red & Laterite Zone), Sekhampur
**Cultivar / Variety / Breed name:** Tomato (*Alternaria solani*)

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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